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**Palmer on National Reservations for the Protection of Wild Life.—**

In this circular<sup>1</sup> Dr. Palmer has brought together for handy reference a list of the various National reservations, where birds and wild life in general are afforded protection, together with statistics upon their extent and history of their establishment. Some information is also presented on the species of birds and game found on certain reservations, while a bibliography furnishes titles of various papers dealing with this subject. There are 95 of these reservations at present, located in 27 states and territories, and of these 56 were set aside especially as bird refuges during the past nine years, — W. S.

**Economic Ornithology in Recent Entomological Publications.—**

A résumé of the entire boll weevil investigation, by W. D. Hunter and W. D. Pierce, has been published as a Senate Document.<sup>2</sup> It discusses all kinds of natural enemies of the boll weevil, including birds. A schedule of stomach examinations of birds which had eaten boll weevils, on p. 146, is reprinted from Biological Survey Circular No. 64. The comment on this table is as follows:

"Exhaustive studies of the stomachs of many birds killed in infested cotton fields by the agents of the Biological Survey of this department have emphasized the fact that the birds play a considerable part in the control of the adult boll weevils. The investigation has resulted in a list of 53 species which more or less commonly feed upon the adult weevils....

"It will be noticed that the largest numbers of boll weevils were eaten during the months of July, August, and September, and also that a considerable number are consumed during the hibernating season. The most important birds are those that capture the boll weevil during the winter. According to this table these are the three species of blackbirds, two meadowlarks, six species of native sparrows, the pipit, the three species of wrens, and the two species of titmice. It will be noted that only one of the 108 quail stomachs examined showed remains of the boll weevil." On p. 145 is recorded Mr. E. A. Schwarz's observation that in Cuba "*Icterus hypomelas*" has developed a habit of extracting the immature stages from the bolls and squares."

Another weevil (*Lissorhoptrus simplex*) is said to be the most serious insect enemy of growing rice. The larvæ feed on the roots and the adults on the leaves of the rice plant. The only natural enemies recorded are birds, the records (furnished by the Biological Survey) being for the Long-billed Marsh Wren and Mallard Duck. The author of the circular<sup>3</sup> on the rice water-weevil states that Mr. C. E. Hood of the Bureau of Entomology

<sup>1</sup> National Reservations for the Protection of Wild Life. By T. S. Palmer. Circular No. 87, Bureau of Biological Survey, U. S. Department of Agriculture, 8vo., pp. 1-32, figs. 1-5. October 5, 1912.

<sup>2</sup> 62nd Congress, 2nd Session, No. 305, 1912, 188 pp.

<sup>3</sup> Tucker, E. S., No. 152, U. S. Bur. Ent. July 10, 1912, 20 pp.

found remains of this species in bird droppings at Stuttgart, Ark. One of two perfect specimens of the weevil, removed from droppings was found to be alive. This observation parallels that recorded by Osborn<sup>1</sup> that a living specimen of another species of weevil (*Macrops lineatulus*), was found alive in bird excrement.

A third species of weevil, the plum curculio, is comprehensively monographed in Bull. 103 of the Bureau of Entomology (July 13, 1912, 250 pp.). This important pest, which causes an annual loss of several million dollars, has numerous natural enemies among which are 7 species of birds. As early as 1865, Dr. Isaac Trimble recorded that the Baltimore Oriole feeds on this insect. Investigations by the Biological Survey have confirmed this observation and have added the following names of bird enemies of the plum curculio: Orchard Oriole, Rose-breasted Grosbeak, Bank Swallow, Yellow-throated Vireo, Veery, and Hermit Thrush.

In Bulletin 106,<sup>2</sup> "The life history and bionomics of some North American ticks," notes are given on the bird enemies of 5 species of these pests. Most of the records refer to enemies of the North American cattle tick. In this connection, Pycraft is quoted relative to the depraved habit of the African Oxpecker (*Buphaga africana*) of enlarging and feeding at holes in the hides of cattle from which it has removed ticks. This publication also gives many records of the occurrence of ticks upon birds.

Five bird enemies of the spring grain aphid or green bug are mentioned by F. M. Webster and W. J. Phillips in their bulletin<sup>3</sup> on that insect. These records were furnished by the Biological Survey and are part of the results of an investigation of the relations of birds to the green bug carried on at Winston-Salem, N. C., in 1909. A full account of this study will be published in the next Yearbook of the Department of Agriculture.

The first general economic treatment of an interesting group of insects, is Professor Herbert Osborn's "Leafhoppers affecting cereals, grasses, and forage crops (Bull. 108, Sept., 1912). More than 12 pages are devoted to a discussion of the natural enemies, 9 of them to birds. A tabulation is given of all the records (up to Jan., 1912) of leafhoppers found in bird stomachs by the Biological Survey.

The Biological Survey records show that 770 stomachs out of a total of about 47,000 examined contained leafhoppers, a proportion of about 1 in 61. Numerous species of birds are shown to eat comparatively high percentages of Jassidæ as *Setophaga ruticilla*, 13; (based on 17 stomach contents), *Poliophtila cærulea*, 7.17 (39 stomachs), *Poliophtila californica*, 11 (31), *Sitta pygmæa*, 43 (32), *Aimophila ruficeps*, 2.6 (25), *Passerherbulus caudacutus*, 6 (44), *Calypte anna* 5.3 (111), *Dendroica æstiva*, 3.7 (116), *Lanius solitarius*, 6 (47), *Regulus calendula*, 5.7 (300), *Tachycineta thalassina*, 7.62 (80), *Telmatochates palustris*, 4.55, (59), *Thryomanes bewicki*,

<sup>1</sup> Western Stock Journ. & Farmer. 10 p. 101, May, 1880.

<sup>2</sup> Hooker, W. A., Bishopp, F. C., and Wood, H. P., September, 1912.

<sup>3</sup> 110, September, 1912.

3.03 (152), *Vireo huttoni*, 4.7 (58), and *Wilsonia pusilla*, 5.6 (67). In addition several other species of birds, whose food habits are known from examination of a large number of stomachs, eat leafhoppers to an extent of from 1.28 to 3 per cent. of their annual diet. This group includes such common species as *Chordeiles virginianus*, *Sayornis phæbe*, *Archilochus colubris*, *Empidonax difficilis*, *Geothlypis trichas*, *Iridoprocne bicolor*, *Penthestes rufescens*, *Petrochelidon lunifrons*, and *Riparia riparia*.

These 24 species certainly feed as extensively as could reasonably be expected upon this single rather restricted group of insects. In the writer's opinion this is true also of other species among those whose Jassid feeding records are tabulated. But Professor Osborn draws a different conclusion part of which is as follows: "While at first thought we might consider birds as a most important element in control of these insects, a closer study reveals many reasons why they must depend upon them but little as a food supply. Even with this more conservative view in mind, however, the actual conditions as represented by the records of the Biological Survey are rather disappointing since they show that for practically all of our birds the leafhoppers constitute so small a portion of their food supply that birds very properly may be considered as almost negligible in any consideration of the natural agencies of control." (p. 23.)

Let us see what is said regarding some of the other natural checks. Again quoting: "Among the predaceous forms we have as the most abundant and efficient perhaps the little bugs of the family Nabidæ, some of which occur in great abundance in the meadows and pastures where the leafhoppers occur. The most abundant of the species is *Reduviolus ferus* L., which occurs throughout the entire range of the United States and may be found in almost every kind of grassy land. That it is a frequent predator upon the leafhoppers is indicated by its attack upon them when they are taken in the net, although it must be said that they are very seldom found with the insects actually impaled upon their beaks in the field. It is probable that this comes from their puncturing and sucking the blood of the insect very quickly and discarding the dead bodies so promptly as not to be found with them actually impaled. I have no question that they feed upon the leafhoppers as one source of their food supply, and believe them to be one of the principal agencies in keeping the leafhoppers in check." (p. 32.)

Thus probabilities and beliefs as to efficiency give this natural enemy a high rank while nearly five pages of finely printed tabulation showing the extent to which more than 120 species of birds are known to feed upon these insects, show in this author's opinion that "birds very properly may be considered as almost negligible in any consideration of the natural agencies of control."

Another case concerns the genus *Geocoris* in the family Lygæidæ. Several reports that they attack leafhoppers and one definite record elicit the remark that they "certainly must contribute largely toward the reduction of the leafhopper pest." (p. 33.) A page of generalities upon the probable leafhopper enemies among spiders, with no definite instances what-

ever of spiders preying upon these insects preface the following remark: "When we consider the carnivorous habit and observe the immense numbers of spiders in the fields, and realize that in many cases leafhoppers are the most abundant and accessible food supply for them, it is easy to credit the spiders with immense service in this direction." (p. 35.)

In view of the nearly complete lack of evidence these strong claims for the value of spiders and heteroptera, as enemies of leafhoppers, are entirely unjustified. The tone of this section of the discussion of natural enemies, bears no relation to that of the section treating birds; the treatment is illogical and unjust.

Probably on account of long concentration upon the group of leafhoppers, the author has let this really inconsiderable portion of our insect fauna, obscure his sense of proportion. An oak leaf held close to the eyes will hide the world. As a matter of fact leafhoppers are only a small section<sup>1</sup> of one order of insects, and not only are some other groups of this order just as abundant in individuals, but the same is true of many groups in other orders. Birds draw their food from all these sources and there is no evidence that leafhoppers contribute less than their appropriate proportion to the total food of birds.

The author therefore has no right to be disappointed that leafhoppers constitute a small portion of the food of practically all our common birds. So also do the Coccidæ or scale insects, the Tettigidæ among Orthoptera, the Carabidæ, among beetles, etc., but this is no proof that these insects are not preyed upon in the proportion of their abundance to that of insects as a whole. It must be remembered also that animal food as a whole including crustacea, mollusca, arachnida, other invertebrates and vertebrates, forms probably not more than half of the total food of birds, this circumstance reducing by half the percentage required to give any group of animals proportional representation in the subsistence of birds. Furthermore it must be recognized that many common birds have arboreal or other specialized habits that keep them out of grass lands, the metropolis of leafhoppers.

It would be just as reasonable to say that hymenoptera may be considered as negligible in the control of leafhoppers, because only a few species are recorded as parasites of leafhoppers, and the majority of the species leave them alone, yet the author says that this order as a means of control is perhaps far more important than we readily appreciate. It probably cannot be proven that any class of predaceous or parasitic enemies of insects takes more than a small proportion of the total number of any restricted group of the prey (averaging the results for a long series of years).

In brief the arguments made by the author in the case of bird enemies

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<sup>1</sup> For instance the number of species of leaf-hoppers forms only 1.34 per cent of the total number of species in Smith's "Insects of New Jersey" and only 1.22 per cent of the insects of the world as tabulated by Handlirsch (*Die Fossilen Insekten*, Part VI).

of leafhoppers, apply just as well to their other enemies. For instance he says (p. 32) of the genus *Reduviolus* of the Heteroptera, I "believe them to be one of the principal agencies in keeping the leafhoppers in check." Why does he not say the Heteroptera are of no importance as enemies of leafhoppers because only a small proportion of the species have been observed to attack them? This argument would be by no means so far fetched as that relating to birds on p. 23, namely, that as leafhoppers were found in only 170 stomachs out of 47,000 examined, birds "very properly may be considered as negligible in any consideration of the natural agencies of control."

Osborn's further remarks that "it is useless to depend on birds for control of these insects. No amount of 'encouragement for the birds' or efforts to utilize their service in this direction can be expected to have any appreciable effect in reducing the number of leafhoppers, and we may dismiss this idea and turn our attention to other more hopeful agencies," are futile and gratuitous. This relation of enemies to prey is true not only of birds but of all natural enemies under natural conditions. It has been possible only in a very few cases to use any kind of natural enemies with striking success and as for control, it has never been accomplished except for limited areas by methods such as are now used in the distribution of the ladybird *Hippodamia convergens* by the California Board of Horticulture.

Some find it difficult to accept the inevitable truths regarding natural enemies, but happily extravagant claims for this enemy or condemnation of that, are largely disappearing from modern publications. All natural enemies should be given credit for useful tendencies, and their protection urged, but the fact must never be obscured that to obtain the degree of control necessary to commercial success, man must practically invariably depend upon direct suppressive measures of his own devising.—W. L. M.

**Economic Ornithology in California.**—Mr. Harold C. Bryant, who is working as a fellow in applied zoölogy on the State Fish and Game Commission foundation in the University of California, is devoting his attention to problems in economic ornithology. With Professor F. E. L. Beal's comprehensive work, embodied in Biological Survey Bulletins 30 and 34, as a general treatment of the subject and with intelligently directed local work such as Mr. Bryant is doing, to fill in the details, the economic ornithology of California will be better understood than that of any other state. Mr. Bryant has already published several papers dealing with his investigations, three of which are here reviewed.

The economic status of the Meadowlark in California, has for some years been a burning question and naturally this problem has occupied much of Mr. Bryant's time. He has recently published a preliminary paper on the subject.<sup>1</sup> Ranchers in the San Joaquin and Sacramento Valleys report the loss of from one-third to one-half of their grain crops

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<sup>1</sup> Monthly Bull. State Comm. Hort. I. No. 6, May, 1912, pp. 226-231.